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Hinge Device

Description

The current invention concerns a hinge device, more specifically, but not necessarily, for the installation of a door on the body of a motor vehicle.

So-called pantograph doors for buses have long been known. In them, a hinge device is formed by a pair of arms whose one end respectively attaches at the level of a body-mounted axis and whose other end attaches at the level of an axis connected to the door. The effective length of these two arms, that is to say, the spacing distance between their two axes, must be equal, and so must also the spacing distance between the two door side axes be equal, on the one hand, and the spacing distance between the two body mounted axes on the other hand, so that the door maintains its orientation upon opening and closing and so that, in an open position, the door can hang next to the door opening and be parallel to said opening against the body.

The parallel movement of the door leads to the situation that, upon closing, such doors are engaged all at once by the totality of their edges into the frame of the door opening, so that if another window or door is not open on the vehicle body, a temporary buildup of excess pressure is generated on the interior of the motor vehicle by the inward movement of the door, said pressure slowing down the movement of the door and, in this manner, hindering the door locking mechanism from catching. Another problem consists therein that when the door is inadvertently opened while the vehicle is being driven, the relative wind - as opposed to the conventional case in which a door is mounted to the body by a single hinge on the front door edge, relative to the direction of travel - can bear down behind the partially opened door and pry it completely wide open.

The object of the current invention is to create a hinge device for connecting a moving part with a stationary part in which, between the two

mutually staggered yet parallelly oriented positions, the stationary part at least runs through a pivoted position relative to these parallel positions.

The task is resolved by a hinge device with the characteristics of claim 1.

When, in the case of the moving parts, we are dealing with a door as described above, these two parallel positions can correspond to a closed door position and to an open arrested door position in which said door rests offset alongside the body, in parallel to the closed position. By virtue of having to run through a pivoted position to get from the closed position to the open parallel position, the movement involved upon closing the door is not an exact parallel translational motion so that a pressure buildup on the interior of the motor vehicle is avoided and the door can fall unobstructed into the lock. With the proper orientation of the pivoted position in terms of the relative wind, the latter exerts a force upon the door that is in the direction of the closed door; an unexpected wide open prying of the door is thus excluded.

In order that between the two end positions of the hinge device head pieces in terms of the arm, two counter running traverse movements of the head pieces are obtained relative to one another, then in a first of these end positions, the spacing distance of a first point of incidence, at which the traction belt impinges upon the first belt pulley, should be smaller from the axis of this first belt pulley than the spacing distance of a second point of incidence, at which the traction belt impinges upon the second belt pulley, from the axis of the second belt pulley, while in the second end position, the spacing distance conditions should be the reverse. Thus, translational conditions are achieved that are respectively greater or smaller than 1 between the rotations of the head pieces relative to the arm in the various end positions.

Preferably, at least the one non-circular belt pulley is elliptical. The other belt pulley is preferably circular or also elliptical.

When both belt pulleys are elliptical, then they should be properly oriented in terms of one another so that a strong swiveling movement of the door can be achieved between the two end positions. For two ellipses of a

given form and with the same circumferential length, the maximal swivel lift is attained when in one position of the first belt pulley in which the points of incidence of the belt at the first belt pulley are the points of intersection of the long axis with the circumference of the ellipse, the points of incidence at the other belt pulley respectively lie at the points of intersection of the short axis with the circumference.

In order to achieve a broad range of free swivel motion for the hinge device, it can be advantageous when the arm is angled and the traction belt between the belt pulleys is guided on two rollers.

Additional characteristics and advantages of the invention emerge from the following description of exemplary embodiments while referencing the appended figures. Are shown in:

Figure 1	a schematic section through a hinge device not in accordance with the invention yet in accordance with a non-published patent application by the applicant;
Figure 2	a section analogous to that in figure 1 through a first form of embodiment of a hinge device in accordance with the invention;
Figure 3	a section analogous to that in figure 1 through a second form of embodiment of a hinge device in accordance with the invention;
Figure 4	a section through a third form of embodiment of the hinge device on the body of a motor vehicle with a closed door;
Figure 5	a section through the third form of embodiment with the door opened up to the stop;
Figure 6	the position of the belt on the belt pulley with the door closed in accordance with a variation of the third form of embodiment; and
Figure 7	the corresponding positions of the belt with the door open.

To clarify the principle of the invention and its effects, we shall first briefly explain the hinge device that is not in accordance with the invention as per Figure 1. The figure shows a horizontal section through a door 1 of a motor vehicle and the posts 8, 9 of the body of a motor vehicle laterally surrounding the door 1. A hinge device generally designated by 10 comprises a first head piece 2 secured to the door 1 and a second head piece 7 secured to the right post 8 as well as an arm 5 to which the head pieces 2, 7 are jointed to respectively pivot around an axis. The arm 5 is comprised by a hollow housing in the interior of which two belt pulleys 3, 6 are respectively connected in a twistproof manner to the head pieces 2 or 7 through openings in the arm 5. An endless traction belt 4 is wrapped around the circumferential surfaces of the two belt pulleys 3, 6.

In the hinge device in Figure 1, the belt pulleys 3, 6 are both circular and have the same diameter so that a rotation of the head piece 2 or 7 relative to the arm 5 is translated with the aid of the traction belt 4 in a rotation of equal degree by the respective other head piece 7 or 2. As a consequence, upon movement from a closed to an open position, the door 1 always maintains the same orientation between the posts 8, 9.

The first form of embodiment of the hinge device 11 in accordance with the invention shown in figure 2 corresponds to that shown in Figure 1 in all that was stated above with the exception of the form of the first belt pulley 3. In the form of embodiment shown in Figure 2, said belt pulley has a non-circular, or more specifically stated, an elliptical profile. In the closed position of the door 1, between the posts 8, 9, lie the points of incidence 12, 13, at which the two strands of the traction belt 4 tangentially contact the belt pulley 3, essentially on a short axis of the ellipse designated by the dashed line K. (An exact position of the points of incidence on the short axis K would result if the strands of the traction belt 4 were to run parallel between the belt pulleys 3, 6; however, this deviation has been omitted in the context of the current description since it has no significance for the functioning mode of the hinge device in accordance with the invention.) The spacing distance of the points

of incidence 12, 13 from the axis of the belt pulley 3, in the closed position of the door 1, is smaller than the spacing distance of the corresponding points of incidence 14, 15 from the axis of the circular belt pulley 6 of the head piece 7 secured to the post 8. The translational relation between the head piece 7and the headpiece 2 is therefore slightly greater than 1 in the closed position so that when the arm 5 pivots around the axis of the head piece 7 upon opening of the door, this pivoting movement is not only counteracted by the corresponding rotation of the head piece 2 in terms of the arm 2, but it is overcompensated. Upon opening the door, the edge 16 of the door adjacent to the post 8 moves faster away from the door opening than the edge 17 adjacent to the post 9, and the door 1 runs through an intermediate position, represented by the dashed line outline in figure 2, in which it is clearly swung in terms of its orientation in the closed position. Accordingly, upon closing of the door 1, first the edge 17 comes to rest up against the post 9 and then the edge 16 comes against the post 8 so that a buildup of pressure on the interior of the vehicle is avoided upon closing of the door.

Assuming that the direction of travel of the vehicle runs from right to left in the figure, the relative wind would hit obliquely on the outside of the partially opened door represented in Figure 2 as the dashed line outline. The door 1 would thus be pushed into its closed position by the relative wind if it had been opened while the vehicle was traveling. Thus, an unintended prying open of the door by the relative wind would be excluded during travel.

To the extent of the manner in which the arm 5 is swung, the points of incidence 12 through 15 of the traction belt 4 on the belt pulleys 3, 6 wander, whereby the spacing distance of the points of incidence 12, 13 from the rotational axis of the belt pulley 3 continuously increases, while the corresponding spacing distance for the points of incidence 14, 15 of the circular belt pulley 6 remains the same. The greater the spacing distance becomes at the belt pulley 3, the smaller the translational relation becomes so that the initial pivoting movement of the door in the counterclockwise direction over the course of opening becomes slower and slower and finally

reverses its direction. In the open position of the door 1, once more represented by dashed lines, the points of incidence 12, 13 respectively lie at the point of intersection of a long axis L of the ellipse with the circumferential surface of the belt pulley 3, and the orientation of the door is the same as in the closed position.

The prerequisite condition for the orientational positions of the door to be the same in the open position as in the closed position consists therein that the path traveled by the points of incidence be the same on the two belt pulleys upon opening and closing. In the case represented here, of a freely pivoting movement of 90° between the open and closed position, this corresponds to the requirement that the circumferential length of both belt pulleys 3, 6 must be the same. Based on the full scale enlargement or reduction of the belt pulley 3 relative to the belt pulley 6, one can however achieve the effect that with an angle of traverse of less than 90° or precisely with an angle of traverse of more than 90°, the door can once more assume an orientation that is parallel to its closed position.

While in Figure 2, the belt pulley 3 on the door side is elliptical and the belt pulley 6 on the post side is circular, the same result could be achieved by using a circular belt pulley 3 on the side of the door 1 and an elliptical belt pulley 6 on the side of the post 8, however with an orientation of the elliptical belt pulley rotated by 90°as compared to the orientation in Figure 2, so that once more in the closed position of the door, the spacing distance of the points of incidence 14,15 of the traction belt on the belt pulley 6 is greater and in the open position, it is smaller than the spacing distance of the points of incidence 12, 13 on the belt pulley 3.

An intensification of the swivel movement is achieved in that, as shown in the exemplary embodiment of figure 3, both belt pulleys 3, 6 are selected to be elliptical with the same dimensions, but with the long axes L that are oppositely rotated relative to one another. If the long axes L were not oppositely rotated, but rather parallel to one another, the door 1 would not

swivel in its movement. A maximal swivel lift is achieved when the long axes L of the two ellipses are oriented to be perpendicular to one another.

Figures 4 and 5 show a third form of embodiment of a hinge device in accordance with the invention that is on the door of a motor vehicle. Parts in these figures that are identical or that have the same function as those parts shown in Figures 1 - 3 bear the same reference number and shall not again be explained in detail. The hinge device 20 here, according to this third form of embodiment, distinguishes itself from those in Figures 2 and 3 by the angled form of its arm 5. The traction belt 4 on the inside of the arm is guided by two rollers 21 at an angle of 90°. The belt pulleys 3, 6 around which the traction belt 4 loops are both elliptical just as in the form of embodiment in Figure 3, and in the closed position in Figure 4, the points of incidence 12, 13 of the belt on the belt pulley 3 are located at the intersecting points of their short axis K with the circumference, and the points of incidence 14, 15 of the belt pulley 6 are located at the intersecting points of the long axis L with the circumference. Based on this positioning, it is ensured that directly at the beginning of the opening movement of the door 1, the translational relation of the belt pulleys 3, 6 most pronouncedly deviates from 1 and then subsequently and continuously approaches 1 and finally becomes less than 1. Based on the angulation of the arm 5, the long axes L of both ellipses are parallel here.

As already explained in reference to Figure 2, based on the spacing distances of the points of incidence 12 through 15 from the rotational axes of their belt pulleys 3, 6, the result is that the door 1 initially swings in the counterclockwise direction upon opening. Over the course of the opening movement, the swinging movement changes its direction to the extent that the points of incidence 12, 13 come closer to the intersecting point with the short axis K and to the extent the points of incidence 14, 15 come closer to the intersecting point with the long axis L. In this form of embodiment, a stop position which corresponds to the full opening of the door 1 is only attained at the end of a traverse movement of 135°, as shown in Figure 5. In this position, the points of incidence 12, 13 on the belt pulley 3 have already

moved past the intersecting points with the long axis and the points of incidence 14,15 on the belt pulley 6 have also moved past the intersecting points with the short axis. Nevertheless, the orientation of the door 1 in the open stop position is exactly parallel to the orientation in the closed position because the dimensions of the two belt pulleys 3, 6 have been selected to just slightly differ from one another.

Another possibility for ensuring parallel orientational positions of the door in the closed state and in the open stop state with two identical belt pulleys 3, 6 is represented in Figures 6 and 7, whereby here, for the sake of obtaining an overview, the arm 5 has only been partially drawn in and the belt pulleys 3, 6 have been enlarged in their representation. If $\forall$ is the angle of traverse between the closed and the opened position of the door, and the arm 5 is angled off by an angle G of 90° here, then the points of incidence 11 through 15 in the closed and opened position are respectively angularly displaced, in the manner shown, by an angle of $2 = (\forall - Q) / 2$ toward an intersecting point of the long and/or short axis L, K with the circumference of the belt pulley.